



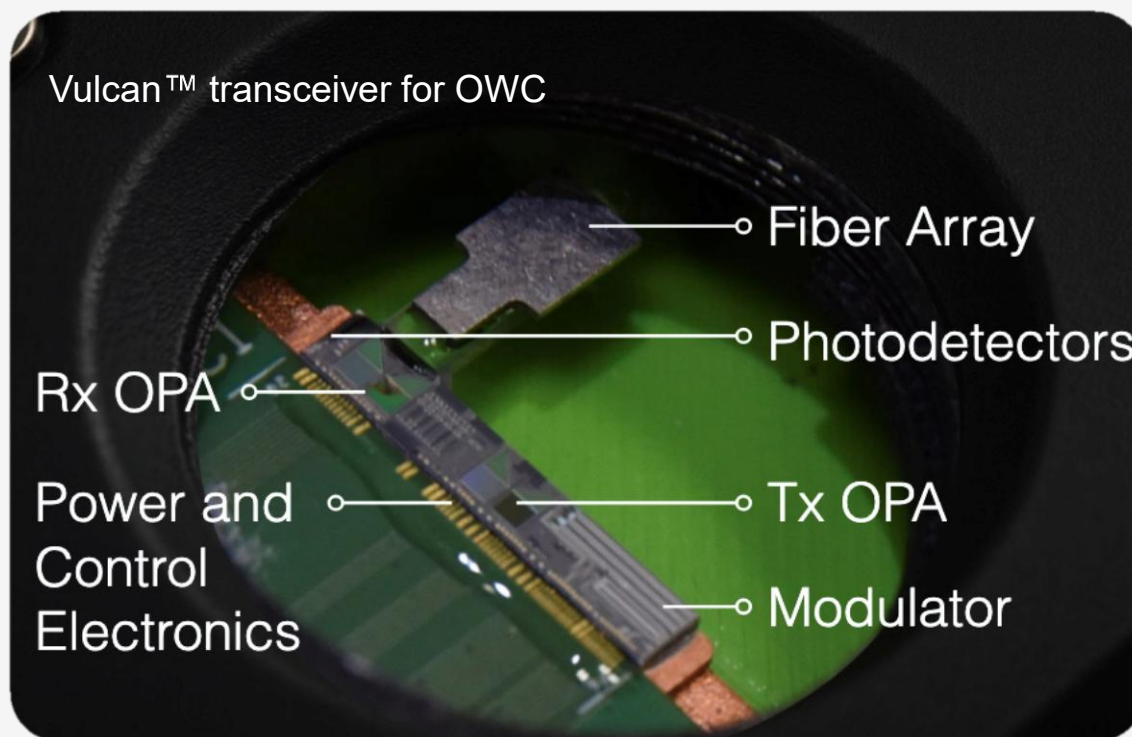
Light Beyond Fiber
Towards fully integrated,
adaptive Earth-to-Space
optical terminals

What We Build: Integrated OWC Transceivers

Integrated Photonics for Optical Wireless Communications

- ✓ Chip-scale beam steering through Optical Phase Arrays (OPAs) enables radically **lower SWaP** with no moving parts.
- ✓ Semiconductor manufacturing delivers **true scalability**, **cost efficiency**, and repeatability.
- ✓ Enabling **Full System Integration**: This approach is the backbone of our roadmap toward fully integrated transceivers, shrinking entire OWC terminals to chip-level form factors.

Transforms OWC into a practical solution for drones, small cells, edge devices or even space communications.

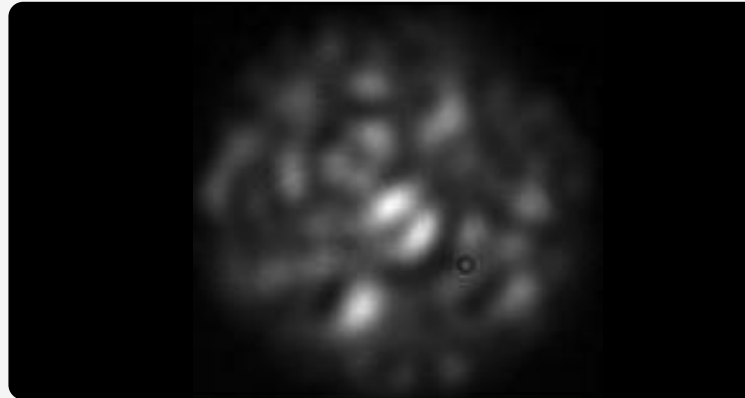


Challenges in Earth-to-Space Optical Communications



High optical power

- **Watt-level of optical power** required for multi-gbps uplinks.
- Power handling limited by **losses, heating and nonlinearities**.
- Efficient **beam generation and combining** is critical.



Atmospheric turbulence

- **Beam wander, scintillation and wavefront distortion**.
- Strong impact on **beam quality and link margin**.
- Requires fast **adaptive wavefront compensation**.



PAT & Point-ahead

- Narrow beams require **μ rad-level pointing accuracy**.
- **Fast tracking and jitter compensation** beyond coarse gimbal pointing.
- Point-ahead angle limits **uplink/downlink reciprocity**.

The Product

Vulcan™ Core

- ✓ OPA based TRx chip with COTS fiber optic transceivers.
- ✓ Static / Transportable Applications, no moving parts.
- ✓ Fine tracking capability
- ✓ Customizable Optics & Modular design
- ✓ Kilometer connectivity at fiber-like speeds



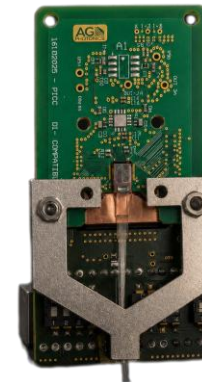
Vulcan™ Coarse

- ✓ OPA based TRx chip with COTS fiber optic transceivers
- ✓ Gimbal-mounted gyro-stabilized for coarse pointing on small moving platforms.
- ✓ COTS Transceiver & Control Electronics in static base.

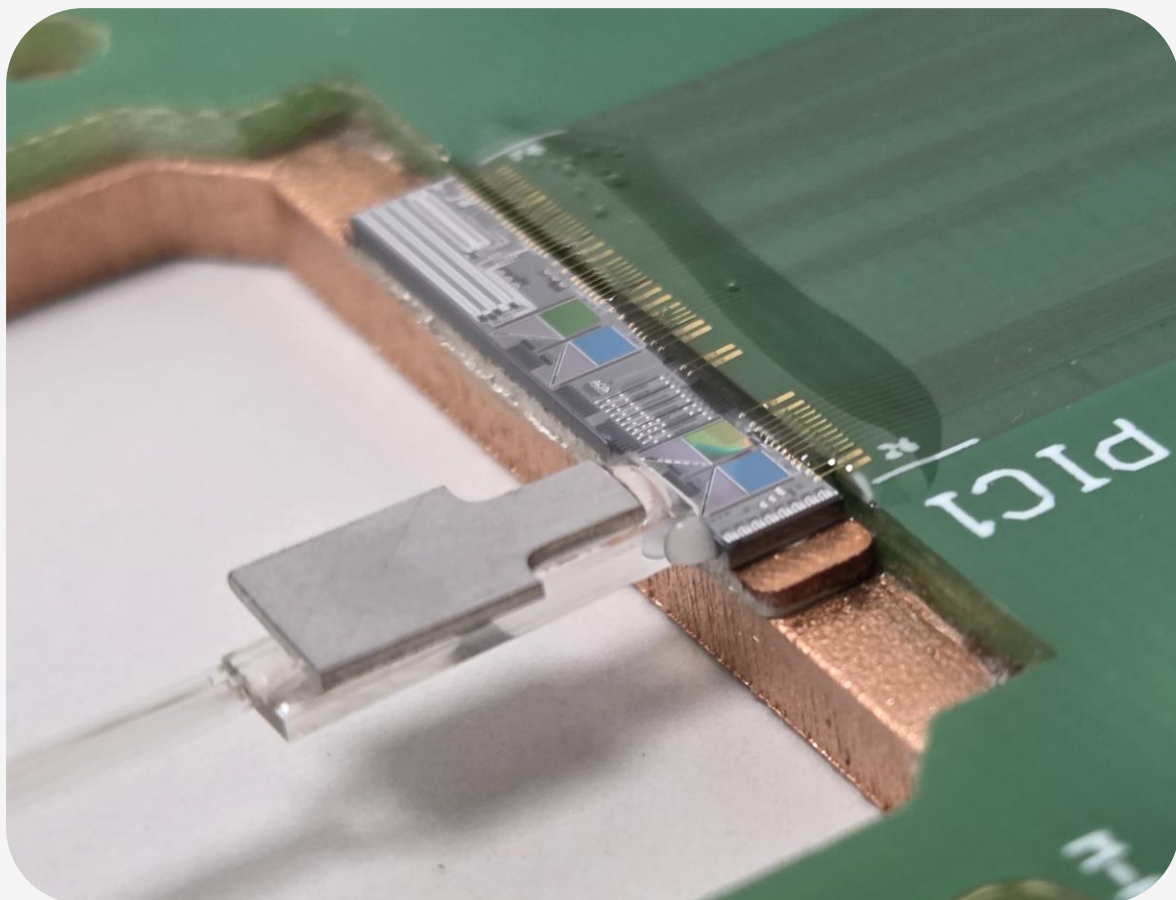


Vulcan™ Core OEM

- ✓ OPA based TRx chip with front-end electronics
- ✓ Fiber to Free-space OWC Interface.
- ✓ Simultaneous steering of transmit and receive beams
- ✓ Coherent combination



Our Core Technology



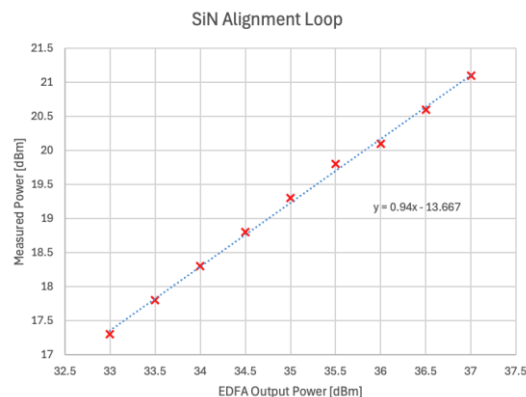
AGPhotonics' OPA Architecture

- **Self-calibrated antenna array:** No need of tuning each phase of each antenna for having a clear beam. Linear phase directly applied on all the antenna array.
- **Simplified control electronics:** Tip/tilt beam steering requires only a single-digit number of electrical control signals.
- **Multi-aperture architecture:** Multiple independently controlled apertures can be integrated on the same PIC, enabling spatial diversity and independent Tx/Rx beam pointing.
- **Grating-lobe suppression:** Proprietary techniques improve radiation efficiency while mitigating unwanted grating lobes.
- **Fixed-wavelength operation:** Beam steering requires no wavelength tuning. Current devices operate at 1550 nm and can be redesigned for other wavelengths.
- **Patented architecture:** The array architecture and antenna topology are protected by AGPhotonics' IP.

High-power integrated apertures

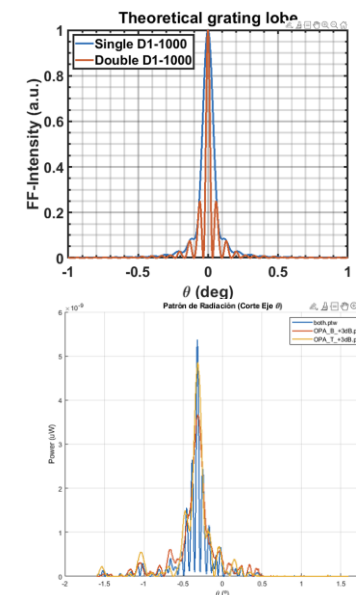
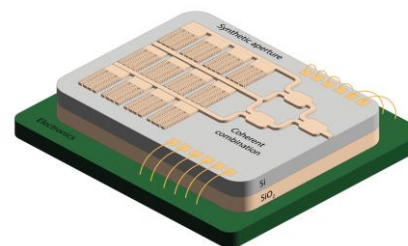
Hybrid SiN/SOI High-Power Platform

- SiN handles and distributes high optical power with low propagation loss and reduced nonlinear effects. SOI is our main platform for the OPA development.
- Power splitting done in SiN and Radiation done in SOI OPAs.
- Up to 27 dBm of radiated optical power from OPA demonstrated in the lab with no aberrations in the main lobe.



Coherent Multi-Aperture Emission

- Optical power is distributed among **multiple independent radiating apertures** and **coherently combined** in free space. Experimentally demonstrated 3 dB increase in directivity per additional aperture.
- Shorter individual apertures preserve phase coherence and reduce accumulated propagation and phase errors across the PIC.



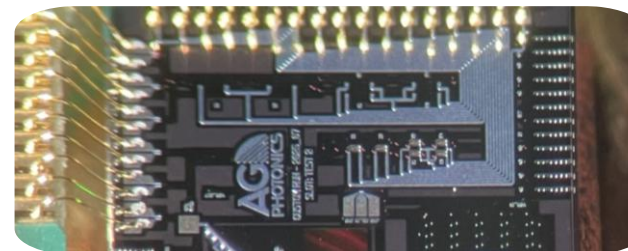
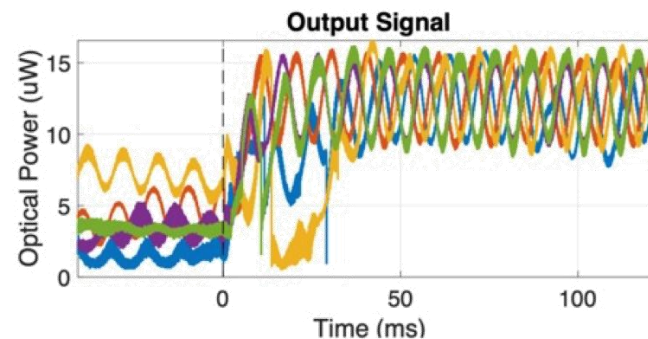
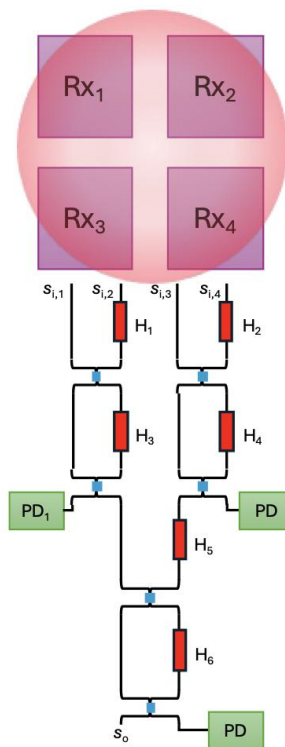
Multi-OPA Architecture for Turbulence-Resilient Optical Links

Our approach

- Multiple steerable OPAs sample different wavefront subapertures.
- Coarse common steering extends the receiver field of view.
- Independent fine steering locally maximizes optical coupling.
- A downstream self-configuring photonic mesh coherently combines the collected fields.

Proof-of-Concept

- $4 \times 500 \mu\text{m}^2$ OPAs, ~40 antennas per aperture.
- 1 mm^2 effective aperture.
- Only 8 electrical control signals.
- Coherent recombination in <5 ms, with <0.5 dB loss.



Hybrid PAT: Gimbal system + OPAs

Mechanical gimbal

- Provides **coarse acquisition and wide-angle pointing**.
- Handles large satellite angular excursions.
- Limited by speed, inertia and mechanical jitter.

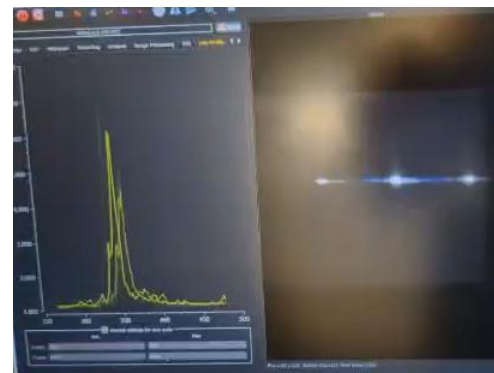
Integrated OPAs

- Provide **fast, fine beam steering** with no moving parts.
- Enable **jitter compensation and μ rad-level tracking**.
- Independent apertures can support **simultaneous Rx tracking and point-ahead-corrected Tx**.

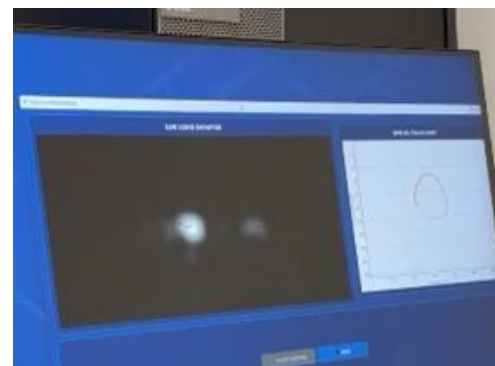
Hybrid architecture

- Gimbal maintains the link within the OPA field of view.
- OPA performs **high-speed fine pointing**.
- Combines **large FoV + fast response + reduced mechanical requirements**.

1st Gen OPA



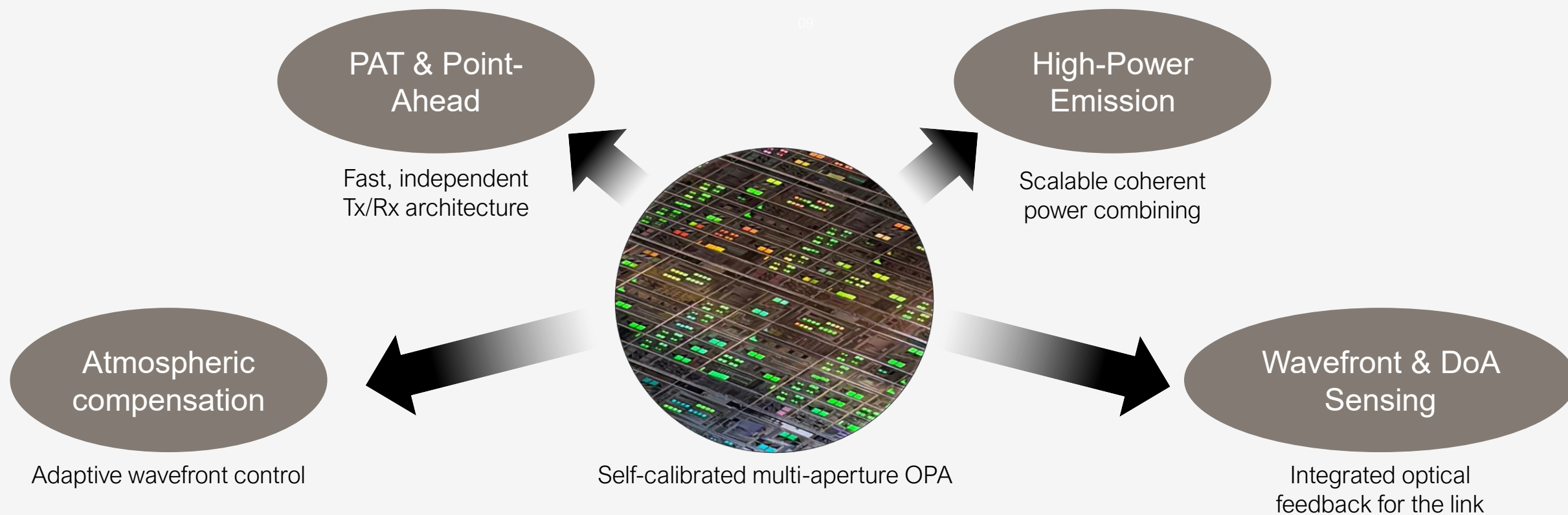
2nd Gen OPA



OPA + Gimbal



One photonic aperture, to rule them all...



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Light Beyond Fiber

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